

copper film interconnect, wherein said neighboring film includes a ruthenium film which substantially prevents voids due to electromigration of copper of the copper film, and said copper film interconnect has a multilayered structure comprising a copper film as formed through sputtering and a copper film as formed through plating.

*D
Conrad*

2. (Twice Amended) A semiconductor device with a multilayered structure comprising a copper film interconnect formed on one primary surface of a semiconductor substrate, and a neighboring film formed in contact with said copper film interconnect, wherein said neighboring film includes a ruthenium film which substantially prevents voids due to electromigration of copper of the copper film, and said copper film interconnect has a multilayered structure comprising a copper film as formed through physical vapor deposition and a copper film as formed through chemical vapor deposition.

D 2

4. (Twice Amended) A semiconductor device with a structure comprising a copper film interconnect formed on one primary surface of a semiconductor substrate, and a plug formed in contact with said copper film interconnect, wherein said plug includes at least one film selected from the group consisting of a rhodium film, a ruthenium film, an iridium film, an osmium film and a platinum film, which substantially prevents voids due to electromigration

O
could

of copper of the copper film, and at least one of said copper film interconnect and said plug contains a layer as formed through physical vapor deposition.

Sub E27
O3

6. (Twice Amended) A semiconductor device with a structure comprising a copper film interconnect formed on one primary surface of a semiconductor substrate, a neighboring film formed in contact with said copper film interconnect, a plug formed in contact with said neighboring film, and a diffusion barrier formed in contact with said plug and said neighboring film, wherein said neighboring film includes ruthenium film, said plug is formed of a ruthenium film, said diffusion barrier is formed of a titanium nitride film, and at least one of said copper film interconnect and said neighboring film is a film formed through sputtering, wherein the neighboring film and the plug substantially prevent voids due to electromigration of the copper or platinum of the copper or platinum film.

O4

9. (Twice Amended) A semiconductor device having a layered interconnection structure including a copper film or a platinum film formed overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes the copper or platinum film and a neighboring film adjacent the copper or platinum film, the neighboring film including a material selected from a first group consisting of rhodium, ruthenium, iridium,

osmium and platinum when the layered interconnection structure includes a copper film and the neighboring film including a material selected from a second group consisting of rhodium, ruthenium, iridium and osmium when the layered interconnection structure includes a platinum film, at least one of (a) the copper or platinum film and (b) the neighboring film being a film made by physical vapor deposition, the device further comprising a diffusion barrier layer, said neighboring film being sandwiched between said copper or platinum film and said diffusion barrier layer, wherein the neighboring film substantially prevents voids due to electromigration of the copper or platinum of the copper or platinum film.

Off
Concl'd

27. (Twice Amended) A semiconductor device having a layered interconnection structure including a copper film formed overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes the copper film and a neighboring film adjacent the copper film, the neighboring film including a material selected from a group consisting of rhodium, ruthenium, iridium, osmium and platinum, at least one of (a) the copper film and (b) the neighboring film being a film made by physical vapor deposition, wherein the neighboring film substantially prevents voids due to electromigration of copper of the copper film.

P5

Please add the following new claims to the application:

P6

--32. A semiconductor device with a multilayered structure comprising a copper film interconnect formed on one primary surface of a semiconductor substrate, and a neighboring film formed in contact with said copper film interconnect, wherein said neighboring film is formed of ruthenium as the primary constituent element, and is formed through sputtering, so as to restrain formation of voids due to electromigration of copper of the copper film interconnect, and said copper film interconnect has a multilayered structure comprising a copper film as formed through sputtering and a copper film as formed through plating or chemical vapor deposition.

33. A semiconductor device having a layered interconnection structure including a copper film formed overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes the copper film and a neighboring film adjacent the copper film, the neighboring film containing a material selected from a group consisting of rhodium, ruthenium, iridium, osmium and platinum as the primary constituent element, at least one of (a) the copper film and (b) the neighboring film being a film made by physical vapor deposition, wherein the neighboring film restrains formation of voids due to electromigration of copper of the copper film.

34. A semiconductor device having a layered interconnection structure including a copper film or a platinum film formed overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes the copper or platinum film and a neighboring film adjacent the copper or platinum film, the neighboring film having, as the primary constituent element thereof, an element selected from a first group consisting of rhodium, ruthenium, iridium, osmium and platinum when the layered interconnection structure includes a copper film, and the neighboring film has, as the primary constituent element thereof, an element selected from a second group consisting of rhodium, ruthenium, iridium and osmium when the layered interconnection structure includes a platinum film, at least one of (a) the copper or platinum film and (b) the neighboring film being a film made by physical vapor deposition, the device further comprising a diffusion barrier layer, said neighboring film being sandwiched between said copper or platinum film and said diffusion barrier layer, wherein the neighboring film restrains formation of voids due to electromigration of copper or platinum of the respective copper or platinum film.

Cont

35. A semiconductor device having a layered interconnection structure including a copper film overlying a surface of a semiconductor substrate,

wherein the layered interconnection structure includes a neighboring film and the copper film overlying the neighboring film, the neighboring film including a material selected from a group consisting of rhodium, ruthenium, iridium, osmium and platinum, and at least one of (a) the copper film and (b) the neighboring film being a film made by physical vapor deposition, wherein the neighboring film substantially prevents voids due to electromigration of the copper film.

SUB E47
cont ~~36.~~ A semiconductor device having a layered interconnection structure

including a copper film overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes the copper film and a neighboring film located at at least one of (a) overlying the copper film and (b) between the copper film and the substrate, the neighboring film including a material selected from a group consisting of rhodium, ruthenium, iridium, osmium and platinum as the primary constituent element, at least one of (a) the copper film and (b) the neighboring film being a film made by physical vapor deposition.

~~37.~~ A semiconductor device having a layered interconnection structure

including a copper film or a platinum film formed overlying a surface of a semiconductor substrate, wherein the layered interconnection structure includes

Sub
E47

the copper film or the platinum film, and a neighboring film located at at least one of (a) overlying the copper film or the platinum film and (b) between the copper film or the platinum film and the substrate, the neighboring film including an element selected from a first group consisting of rhodium, ruthenium, iridium, osmium and platinum when the layered interconnection structure includes the copper film and the neighboring film including an element selected from a group consisting of rhodium, ruthenium, iridium and osmium when the layered interconnection structure includes the platinum film, at least one of (a) the copper film or platinum film and (b) the neighboring film being a film made by physical vapor deposition, wherein the neighboring film substantially prevents voids due to electromigration of platinum and the neighboring film substantially prevents voids due to electromigration of copper.--

R. J. Connelly